AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) A system comprising:

a) a laser operable to emit a femtosecond laser beam pulse;

b) a ~~binary~~ phase shaper operable to shape the pulse with binary phase values; and

c) a controller operable to automatically control the laser and the shaper.

2. (original) The system of Claim 1, wherein the shaper employs two phase values separated by π.

3. (currently amended) The system of Claim 1 further comprising multiphoton intrapulse interference phase scan software, for pulse characterization and compensation, used by the controller.

4. (currently amended) The system of Claim 1 further comprising evolutionary learning calculations used by the controller.

5. (withdrawn) The system of Claim 1, wherein the system is employed in multiphoton microscopy.

6. (withdrawn) The system of Claim 1, wherein the system is employed in an optical communications system.

7. (original) The system of Claim 1, wherein the pulse shaper has one of the following pixel resolutions: (a) about 128; (b) about 512; (c) about 640; and (d) about 1024.

8. (original) The system of Claim 7, wherein the bandwidth of the laser is dispersed across all pixels of the phase modulator.

9. (original) The system of Claim 1, wherein the system is employed in optical coherence tomography.

10. (withdrawn) The system of Claim 1, wherein the system is employed in microlithography.

11. (original) The system of Claim 1, wherein the system is employed in functional imaging.

12. (withdrawn) The system of Claim 1, wherein the system is employed in quantum information processing.

13. (withdrawn) The system of Claim 1, wherein the system is employed in nonlinear optical excitation spectroscopy.

14. (original) The system of Claim 1, wherein the system is employed in photodynamic therapy.

15. (withdrawn) A system comprising:

a) a laser beam pulse;

b) a binary phase shaper operable to shape the laser beam pulse with encoded characteristics;

c) a nonlinear optical medium operable to separate multiple frequencies of the pulse;

d) a detection device operable to detect the characteristics of the shaped laser beam pulse as separated by the nonlinear optical medium; and

e) a unit connected to the device operably decoding the characteristics.

16. (withdrawn) The system of Claim 15, wherein the laser beam pulse is encoded with a routing address.

17-19. (cancelled).

20. (withdrawn) The system of Claim 15 further comprising:

a main transmitting controller; and

multiple remote initial-transmitting sources connected to the transmitting controller;

the main transmitting controller operably causing the pulse shaper to encode multiple successive laser beam pulses differently in an active manner.

21. (cancelled).

22. (withdrawn) The system of Claim 15 further comprising a fiber optic cable carrying the laser beam pulse from the pulse shaper.

23-25. (cancelled).

26. (original) A system for use with living tissue, the system comprising:

a high peak intensity laser beam pulse; and

a device operable to change a characteristic of the pulse prior to emission of the pulse upon the living tissue through use of multiphoton intrapulse interference;

wherein nonlinear transitions induced by each pulse are controlled by binary phase shaping.

27. (original) The system of Claim 26 wherein the device uses a pulse shaper and the desired excited substances in the tissue undergo two photon absorption.

28. (currently amended) The system of Claim 26 wherein the pulse has a duration of less than fifty one femtoseconds <u>and values used in the binary phase shaping are predetermined</u>.

29. (original) The system of Claim 26 further comprising generating an optical tomography image produced by the shaped pulse passing through the tissue.

30. (original) The system of Claim 26 wherein the device is a pulse shaper which enhances two photon absorption by a therapeutic substance and substantially prevents three photon induced damage of adjacent healthy tissue.

31. (original) The system of Claim 26 wherein the device includes a phase modulation mask operably modifying the beam.

32. (original) The system of Claim 26 wherein the pulse is shaped to enhance targeted multiphoton damage to modify or destroy certain molecules in the living tissue.

33. (original) The system of Claim 26 wherein the multiphoton intrapulse interference operably activates desired photodynamic therapy agents at desired tissue depths.

34. (withdrawn and currently amended) A system for multiphoton microscopy, the system comprising:

a) a femtosecond laser operable to emit a laser pulse;

b) a target operable to hold a sample in the pulse;

c) the sample operably labeled with at least one fluorescent probe;

d) a binary phase shaper operable to shape the pulse to selective excitation of the probe <u>and to correct for phase distortions</u>; and

e) a detector operably detecting an emission from the sample.

35. (withdrawn) The system of Claim 34, further comprising multiple probes.

36. (withdrawn) The system of Claim 35, wherein the shaper operably shapes a probe to selectively excite each of the multiple probes.

37. (withdrawn) The system of Claim 34, wherein the probe includes fluorescent nanoparticles.

38. (withdrawn) The system of Claim 34, wherein the probe is a chemically sensitive fluorescent probe for detecting at least one of: H+, Na+, and Ca++ ions.

39. (withdrawn) The system of Claim 34, further comprising learning calculations.

40. (withdrawn) The system of Claim 34, further comprising a controller operably controlling the laser, the shaper, the target and the detector.

41. (withdrawn and currently amended) The system of Claim 40, wherein the controller is part of a microprocessor, and the controller controls mulitphoton intrapulse interference in the pulse with binary phase values used with the binary phase shaper.

42. (withdrawn and currently amended) The system ~~microprocessor~~ of Claim 41, further comprising a data collector operably collecting data from the detector.

43. (withdrawn and currently amended) The system ~~microprocessor~~ of Claim 42, further comprising a data analyzer operably analyzing the data that is collected.

44. (withdrawn) The system of Claim 34, wherein the shaper is comprised of different phase masks permanently created in a substrate.

45. (withdrawn) The system of Claim 34, wherein the detector operably converts the emission so that it is viewable by a human eye.

46. (withdrawn) The system of Claim 34, wherein the sample is labeled with quantum dots.

47. (currently amended) A method for microscopy of a target material containing probes that are excitable by multiphoton ~~multi-photon~~ excitation, the method comprising:

a) generating a laser pulse;

b) shaping the pulse using a binary phase shaper employing binary phase functions so that the pulse selectively excites a desired probe by the multiphoton excitation;

c) directing the shaped pulse at the target; and

d) detecting emissions from the target.

48. (original) The method of Claim 47, further comprising shaping the pulse by the use of learning calculations.

49. (original) The method of Claim 47, wherein the target has multiple probes.

50. (previously presented) The method of Claim 49, further comprising shaping a pulse to selectively excite each of the multiple probes.

51. (original) The method of Claim 47, further comprising shaping the pulse with a spatial light modulator.

52. (original) The method of Claim 47, wherein the laser pulse is less than 51 femtoseconds, further comprising observing the target with a confocal microscope.

53. (original) A method of pulse shaping, the method comprising:

a) emitting a laser pulse having a duration less than 110 femtoseconds;

b) directing the pulse into a pulse shaper;

c) characterization of the pulse using multi-photon intrapulse interference phase scan; and

d) shaping the pulse by only two phase values.

54. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in multi-photon microscopy.

55. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in optical communications.

56. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in non-linear optical excitation spectroscopy.

57. (original) The method of Claim 53, further comprising using two phases separated by π.

58. (withdrawn) The method of Claim 53, wherein the pulse contains data.

59. (original) The method of Claim 58, further comprising using a spatial light modulator.

60. (original) The method of Claim 59, further comprising shaping the pulse with the spatial light modulator having one of the following pixel resolutions: (a) about 128; (b) about 512; (c) about 640; and (d) about 1024.

61. (withdrawn) The method of Claim 58, wherein the amount of data transmitted in the pulse is equal to or less than 128 bytes per pulse.

62. (original) The method of Claim 53, further comprising using the shaped pulse in microlithography.

63. (original) The method of Claim 77, further comprising using the shaped pulse in photodynamic therapy on living tissue.

64. (withdrawn) The method of Claim 77, further comprising using the shaped pulse in nonlinear optical excitation spectroscopy.

65. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in optical coherence tomography.

66. (withdrawn) The method of Claim 77, further comprising using the shaped pulse in multiphoton microscopy.

67. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in quantum computing.

68. (original) The method of Claim 53, further comprising using the shaped pulse in photodynamic therapy.

69. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in microfabrication.

70. (original) The method of Claim 53, further comprising shaping by binary phase shaping.

71-76. (cancelled).

77. (previously presented) A method of pulse shaping, the method comprising:

a) emitting a laser pulse;

b) directing the pulse into a pulse shaper; and

c) characterization of the pulse using multi-photon intrapulse interference phase scan.

78. (previously presented) The method of Claim 77 wherein the pulse has a duration less than 51 femtoseconds.

79. (previously presented) The method of Claim 77 further comprising automatically compensating for undesired pulse characteristics.

80. (previously presented) The method of Claim 77 further comprising selectively reducing three or more photon excitation.

81-91. (cancelled).

92. (currently amended) A system comprising:

a laser operably emitting a laser beam pulse of less than 51 femtoseconds;

a pulse shaper operably controlling a spectral phase of the pulse;

a detector operably detecting a spectrally dispersed second harmonic of the shaped pulse; and

a controller connected to the shaper and detector, the controller operably controlling ~~the shaper to introduce~~ multiphoton intrapulse interference <u>in</u> [[to]] the pulse.

93. (previously presented) The system of Claim 92 wherein the pulse has a duration less than 10 femtoseconds.

94. (previously presented) The system of Claim 92 further comprising selectively reducing three or more photon excitation.

95. (previously presented) The system of Claim 92 wherein a calibrated reference spectral phase in the pulse shaper is used to retrieve an unknown spectral phase in subsequent pulses.

96. (previously presented) The system of Claim 92 further comprising using a reference spectral phase including a sinusoidal function with the pulse shaper.

97. (previously presented) The system of Claim 92 further comprising using a reference spectral phase including a cubic function with the pulse shaper.

98. (previously presented) The system of Claim 92 further comprising a retrieved unknown spectral phase in the pulse is used to calculate a compensation phase that cancels spectral phase distortions in subsequent laser beam pulses.

99. (previously presented) The system of Claim 92 further comprising using the shaper and controller to conduct multiphoton intrapulse interference phase scans on subsequent laser beam pulses in an iterative manner to improve the quality of pulse control.

100. (new) The system of Claim 1, wherein the controller controls multiphoton intrapulse interference in the pulse with the assistance of the binary phase values.

101. (new) The system of Claim 1, wherein the binary phase values are predetermined prior to emission of the pulse without an evolutionary learning algorithm.

102. (new) The system of Claim 26, wherein the controller uses multiphoton intrapulse interference phase scan software for pulse characterization and compensation.

103. (new) The system of Claim 26, wherein the controller uses evolutionary learning calculations in combination with the binary phase values.

104. (new) The method of Claim 77, further comprising creating a transform-limited pulse with the pulse shaper.

105. (new) The method of Claim 77, further comprising creating a user-specified shaped pulse with the pulse shaper.

106. (new) The method of Claim 77, further comprising obtaining a second harmonic spectrum of the pulse with a second-harmonic generation crystal and a spectrometer.

107. (new) The method of Claim 77, further comprising:

(a) introducing a reference phase function into the pulse by the pulse shaper,

(b) frequency doubling an output;

(c) detecting the second harmonic spectrum in a spectrometer;

(d) determining the phase distortion with a controller; and

(e) subtracting the phase distortion when subsequent phase functions are introduced by the pulse shaper to compensate for phase distortions of the input laser pulse.

108. (new) The method of Claim 77, wherein the pulse shaper includes a spatial light modulator which both introduces a reference phase and compensates for phase distortions.

109. (new) The method of Claim 77, further comprising automatically calculating the second derivative of a spectral phase from a collection of second harmonic spectra obtained as a referenced phase is scanned, and obtaining the spectral phase by integration.

110. (new) The method of Claim 77, further comprising introducing a binary phase function to the pulse in addition to a compensation phase.

111. (new) A system comprising:

(a) a laser emitting a laser beam pulse;

(b) a shaper operably shaping the pulse with binary phase values; and

(c) a controller controlling multiphoton intrapulse interference in the pulse with the assistance of the binary phase values.

112. (new) The system of Claim 111, wherein the controller uses multiphoton intrapulse interference phase scan software for pulse characterization and compensation.

113. (new) The system of Claim 111, wherein the controller uses evolutionary learning calculations in combination with the binary phase values.

114. (new) The system of Claim 111, wherein the bandwidth of the laser is dispersed across all pixels of the phase modulator.

115. (new) The system of Claim 111, wherein the system is employed in optical coherence tomography.

116. (new) The system of Claim 111, wherein the system is employed in functional imaging.

117. (new) The system of Claim 111, wherein the system is employed in photodynamic therapy.

118. (new) The system of Claim 111, wherein the pulse has a duration of less than fifty one femtoseconds and values used in the binary phase shaping are predetermined.

119. (new) The system of Claim 111, further comprising generating an optical tomography image produced by the shaped pulse passing through the tissue.

120. (new) The system of Claim 111, wherein the device is a pulse shaper which enhances two photon absorption by a therapeutic substance and substantially prevents three photon induced damage of adjacent healthy tissue.

121. (new) The system of Claim 111, wherein the device includes a phase modulation mask operably modifying the beam.

122. (new) The system of Claim 111, wherein the pulse is shaped to enhance targeted multiphoton damage to modify or destroy certain molecules in the living tissue.

123. (new) The system of Claim 111, wherein the multiphoton intrapulse interference operably activates desired photodynamic therapy agents at desired tissue depths.